

Methods to Sample *E. coli* in Foreshore Sand and Pore Water

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Introduction



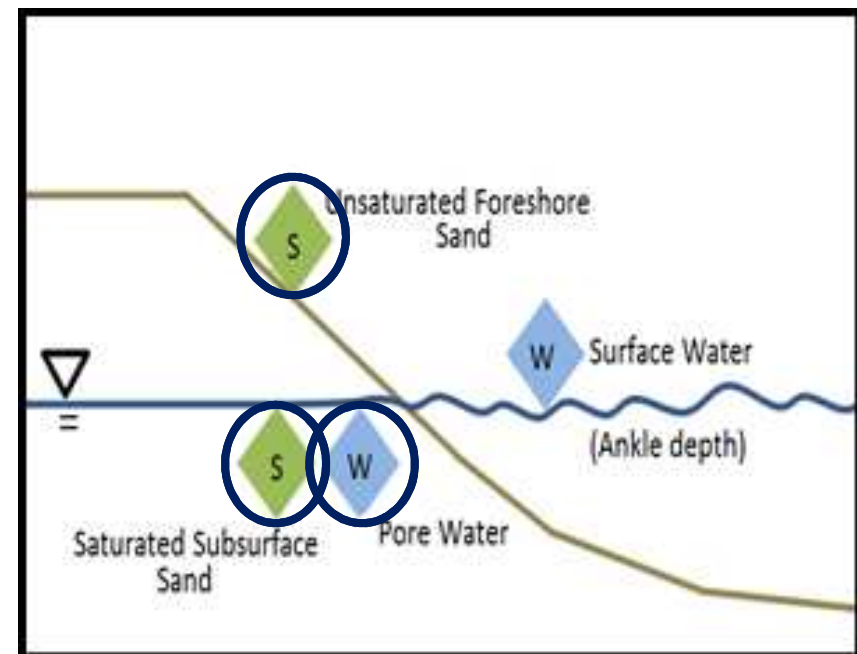
- *E. coli* is often orders of magnitude higher in sand/porewater near the shoreline than shallow lake waters
 - Acts as non-point source for contaminating lake water
- Health units do not currently sample the foreshore reservoir
 - *“Sampling for microorganisms in sand should... be considered for inclusion in regulatory programmes aimed at protecting recreational beach users from infectious disease” (Solo-Gabriele et al. 2015)*

Current sampling methods

1. **Unsaturated foreshore sand**
(Enns et al. 2012, Phillips et al. 2015, etc.)
2. **Saturated foreshore sand**
(Yamahara et al. 2007, Staley et al. 2015, etc.)
3. **Foreshore pore water**
(Boehm et al. 2004, Skalbeck et al. 2010, etc.)

How should we quantify the foreshore reservoir?

Can we compare between studies?

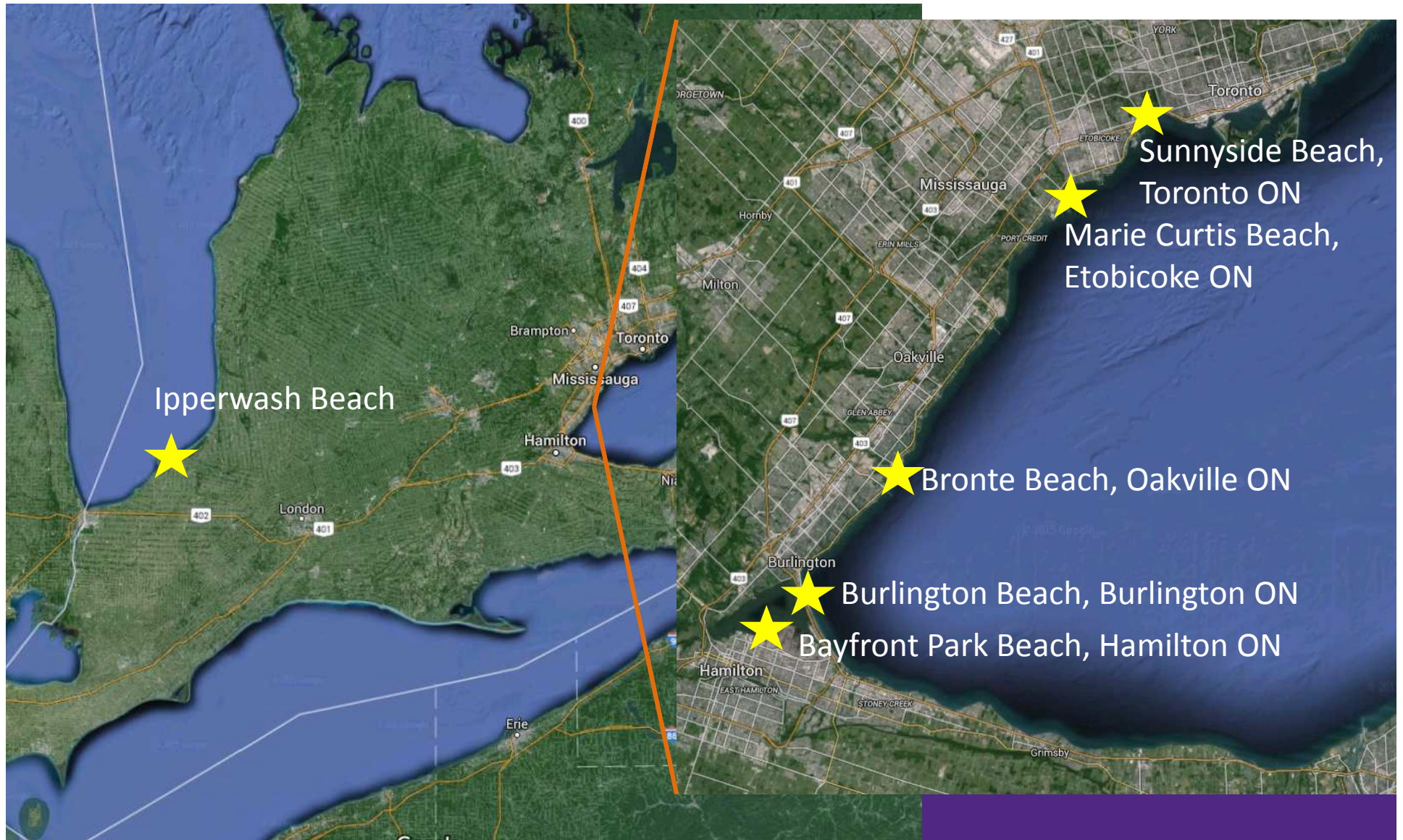


Objectives

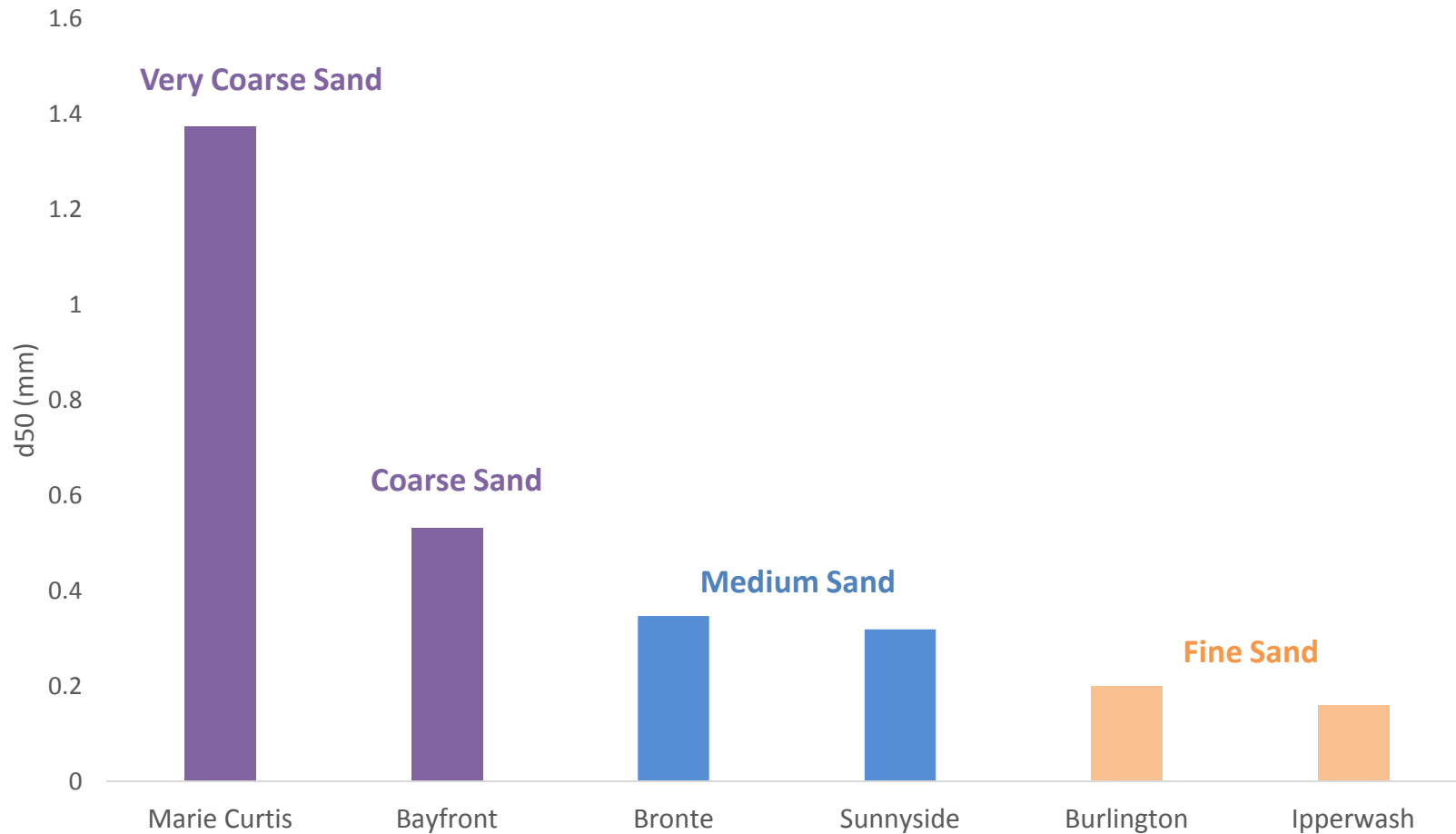
Determine the impact of sampling methods on quantification of *E. coli* in the foreshore reservoir.

1. **Do *E. coli* concentrations vary with sampling method?**
 - ❖ Considering all beaches?
 - ❖ Considering individual beaches?
2. **Which sampling methods are the least variable?**

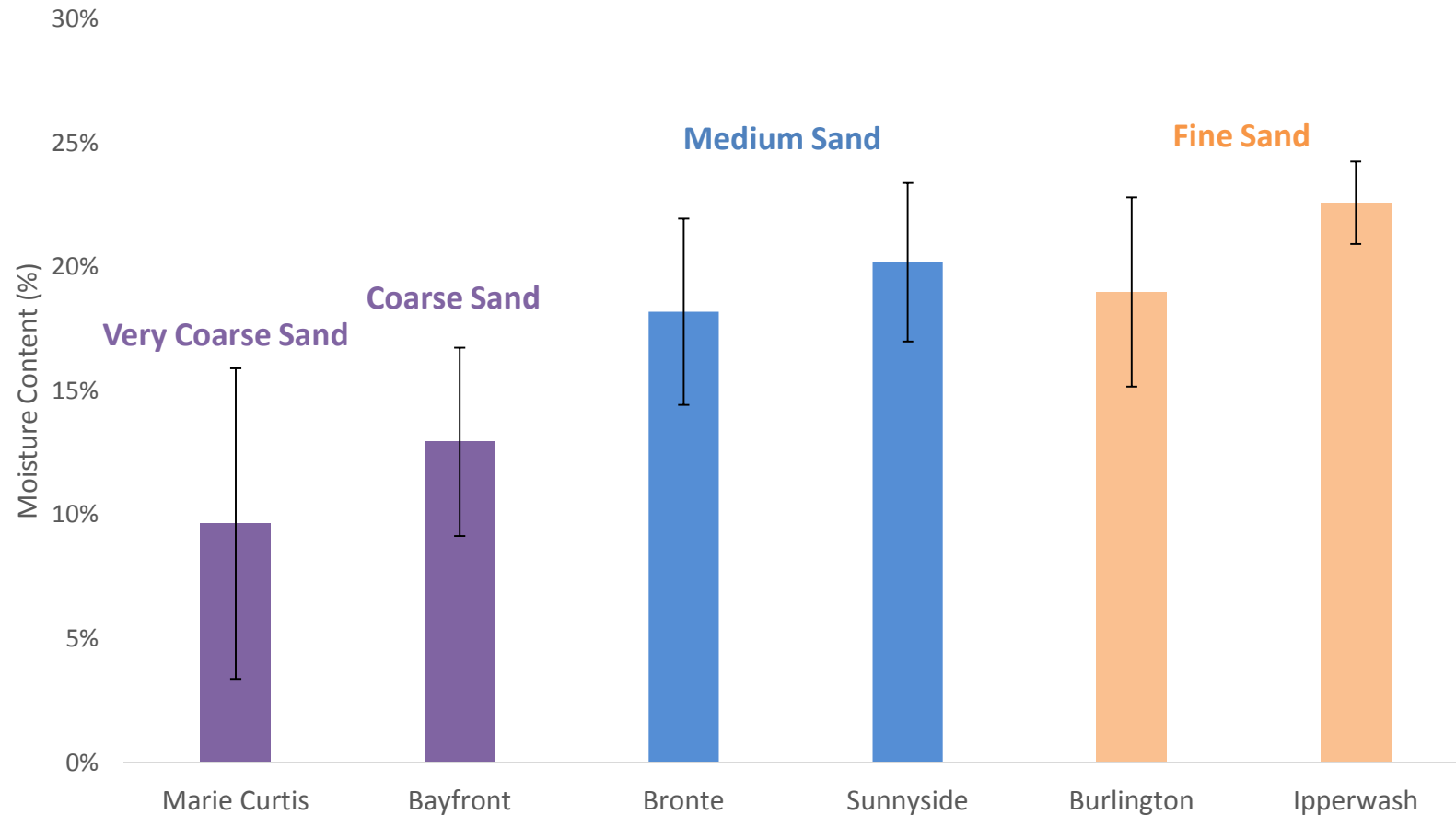
Study Sites



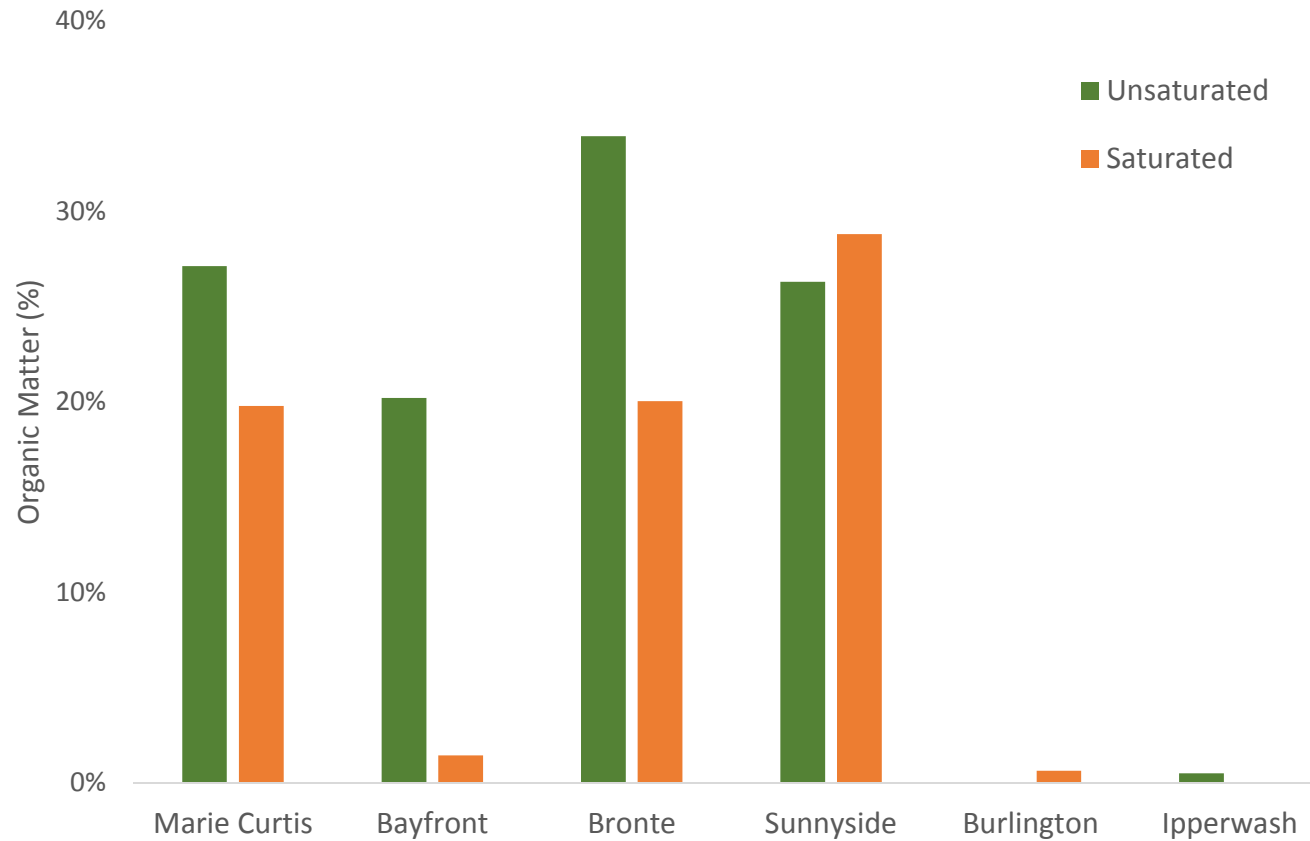
Sand Grain Sizes for Sites



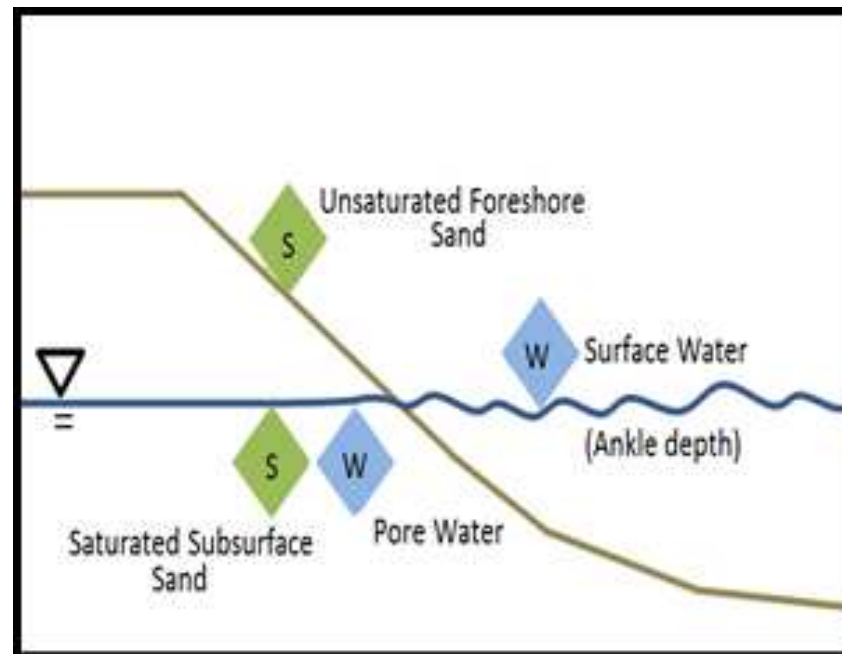
Moisture Content of Unsaturated Sand



Organic Content (%)

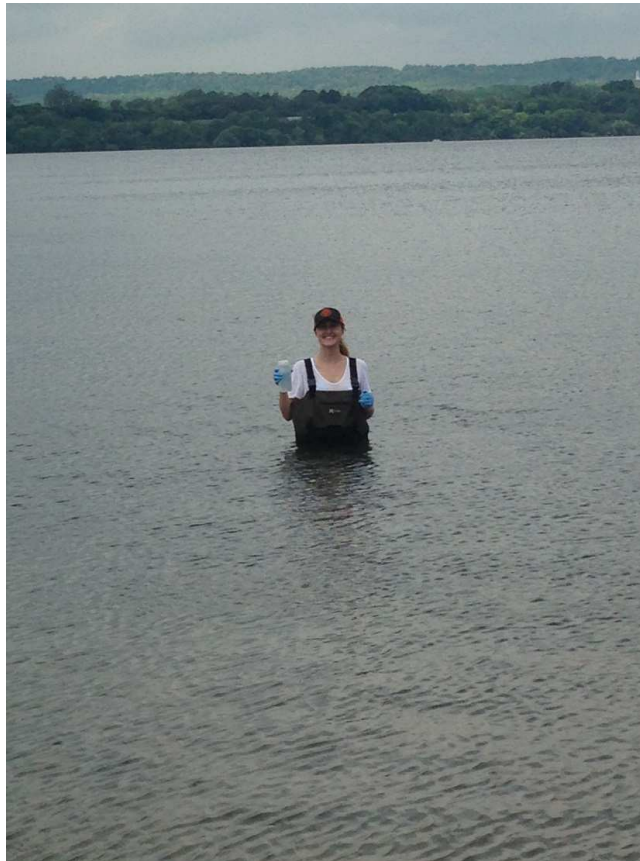


Current sampling methods



Methods Sampling

Surface Water



Methods Sampling – pore water

Shovel



1

Careful Excavation



2

Drive Point



3

Methods Sampling – unsaturated sand

Unsaturated Sand A



Unsaturated Sand B



Methods Sampling – saturated sand

Shovel



1

Careful Excavation



2

Core

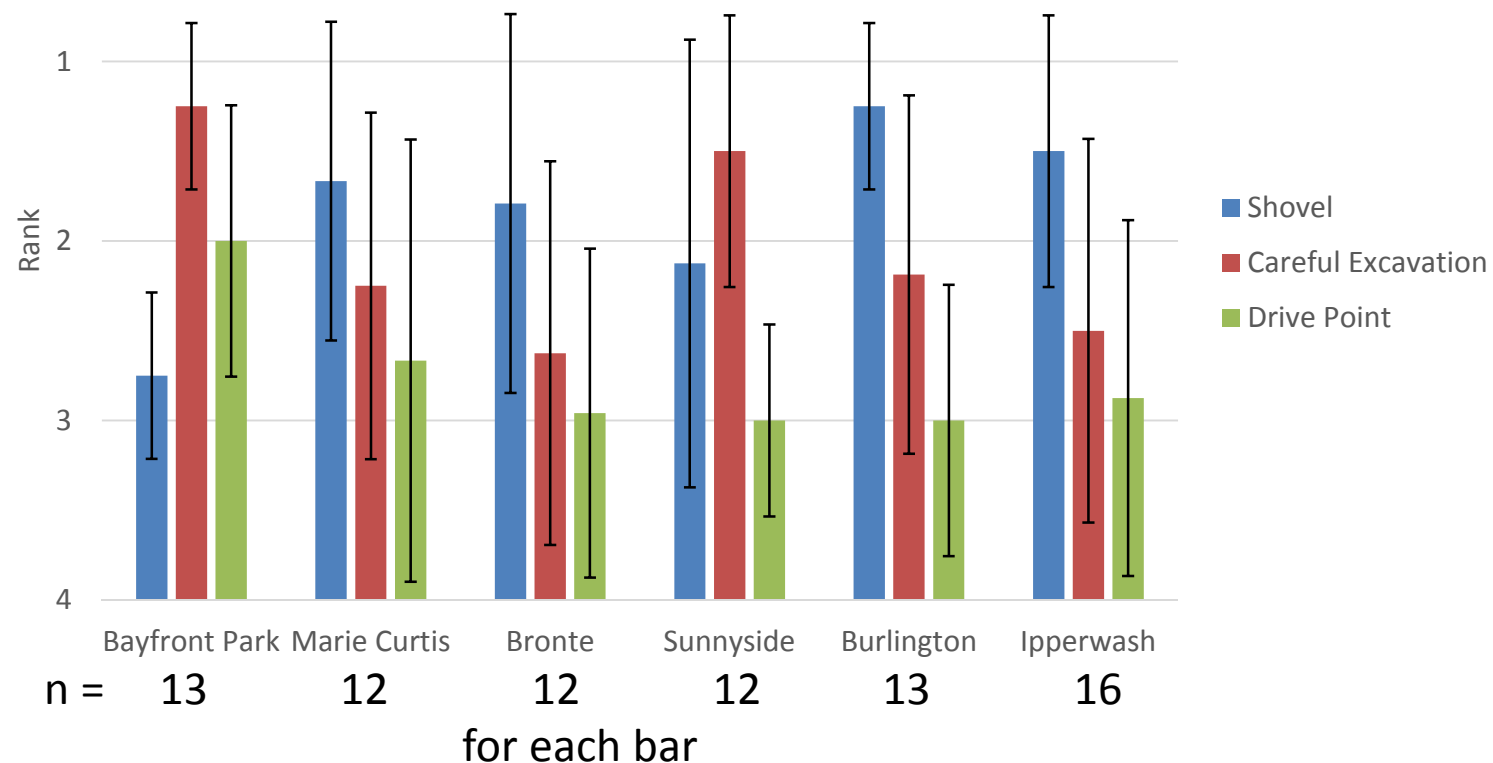


3

**Do *E. coli* concentrations
vary with sampling method?
Considering data for individual
beaches**

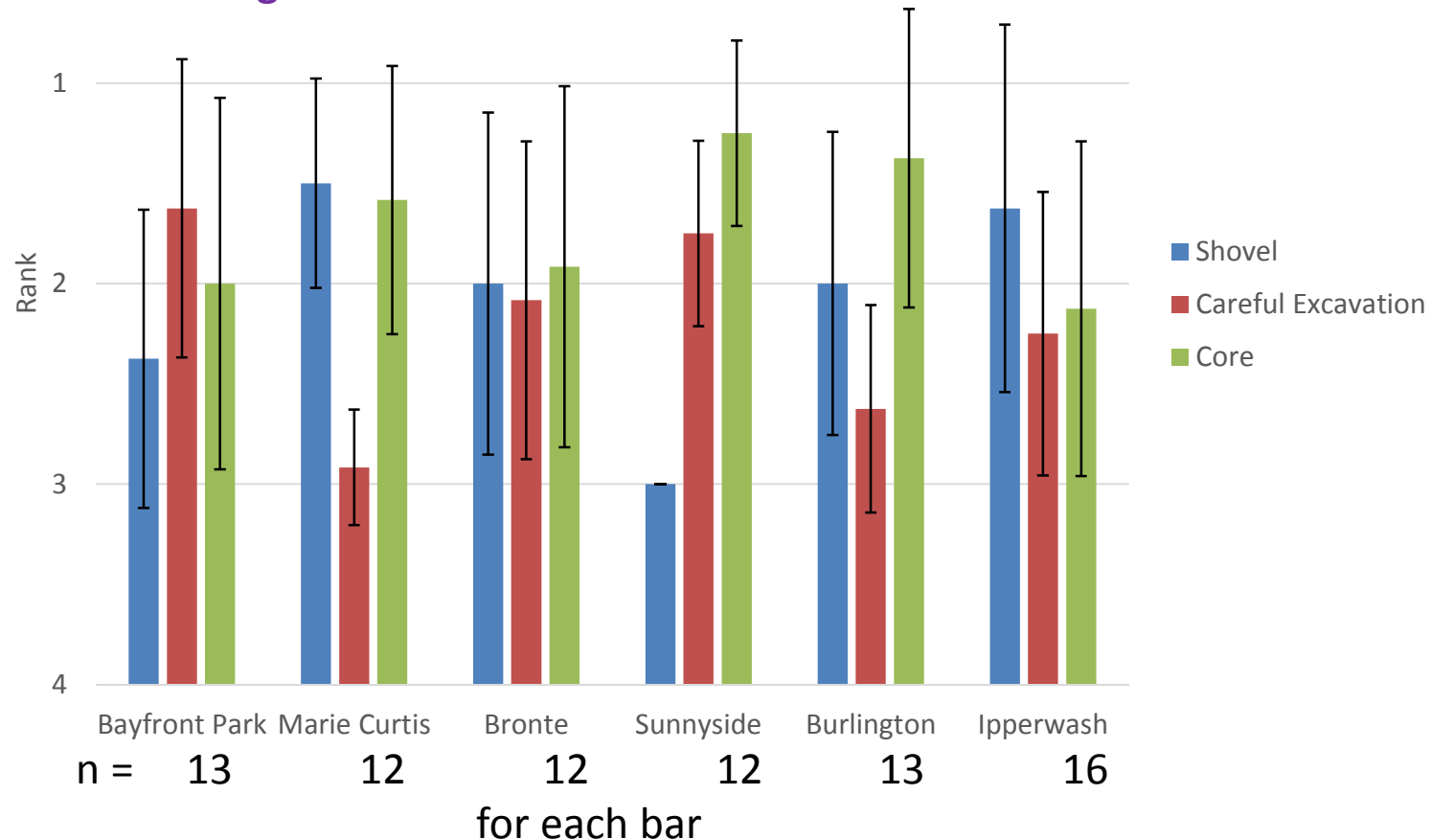
Pore Water Methods

Drive point method resulted in lower concentrations for all beaches except Bayfront Park.

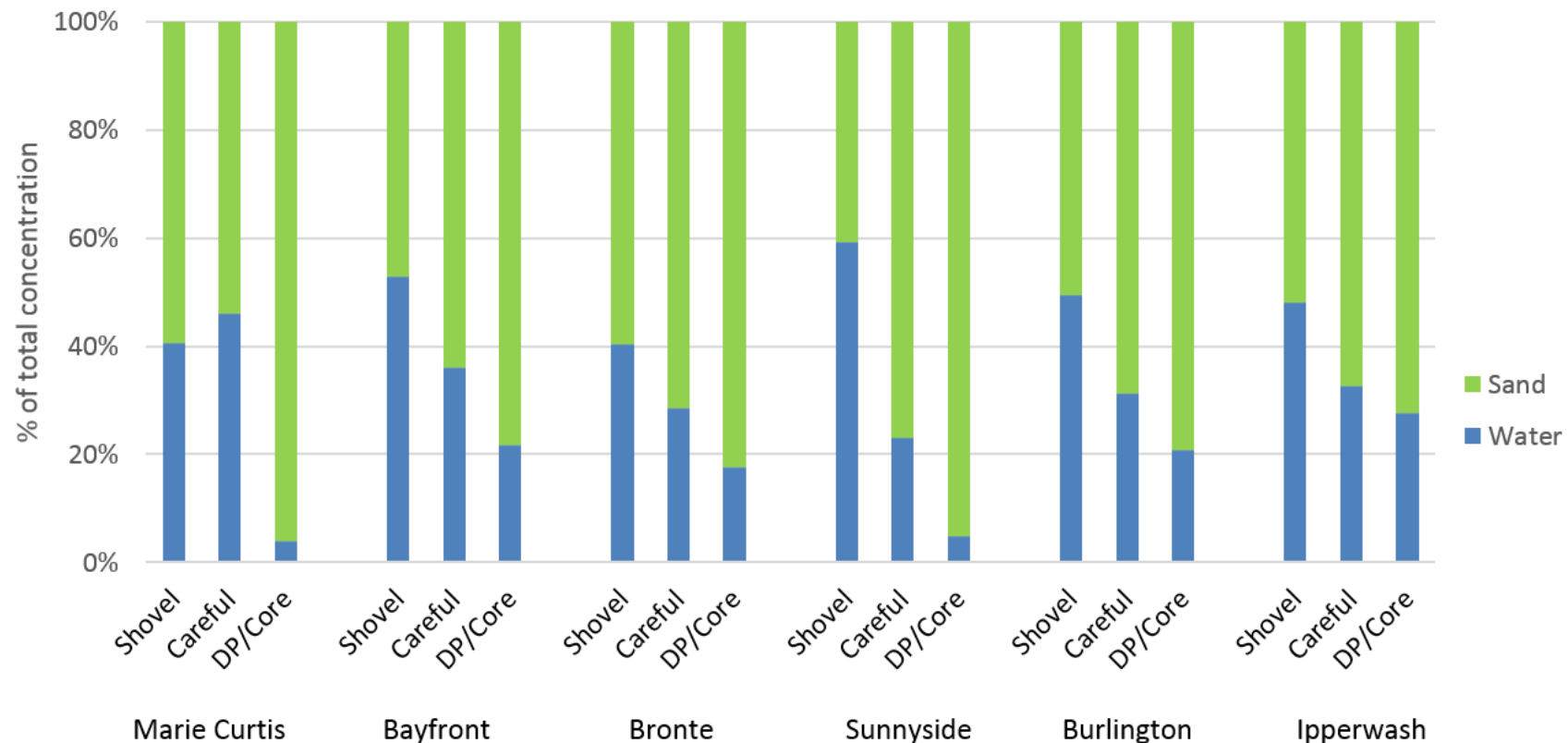


Saturated Sand Methods

Too variable. No significant results.



E. coli distribution



- Standardized by volume (CFU/cm³)
- Using shovel, careful extraction, and core releases (in order) more *E. coli* from sand resulting in lower % amount in sand and higher % amount in porewater

**Do *E. coli* concentrations
vary with sampling method?
Considering data for all beaches**

Comparing methods – Pore water

	N	Median (CFU/100mL)	p-values	Shovel	Careful Excavation
Shovel	78	3300	Shovel	--	--
Careful Excavation	78	960	Careful Excavation	0.2990	--
Drive Point	78	510	Drive Point	0.0029	0.0538



Shovel and careful
extraction methods
results in higher pore
water concentrations
than drive point.

Comparing methods – unsaturated sand

- Unsaturated sand A had statistically **higher concentrations** than unsaturated sand B ($p=0.0041$)
- Unsaturated sand A had statistically **more variable concentrations** than unsaturated sand B ($p=0.014$)



Comparing methods - Saturated sand

	N	Median (CFU/g)
Shovel	78	20.1
Careful Excavation	78	20.6
Core	78	21.9
Unsaturated	78	376.7

p-values	Careful Excavation	Core
Shovel	0.8593	0.1342
Careful Excavation		0.1652
Core		

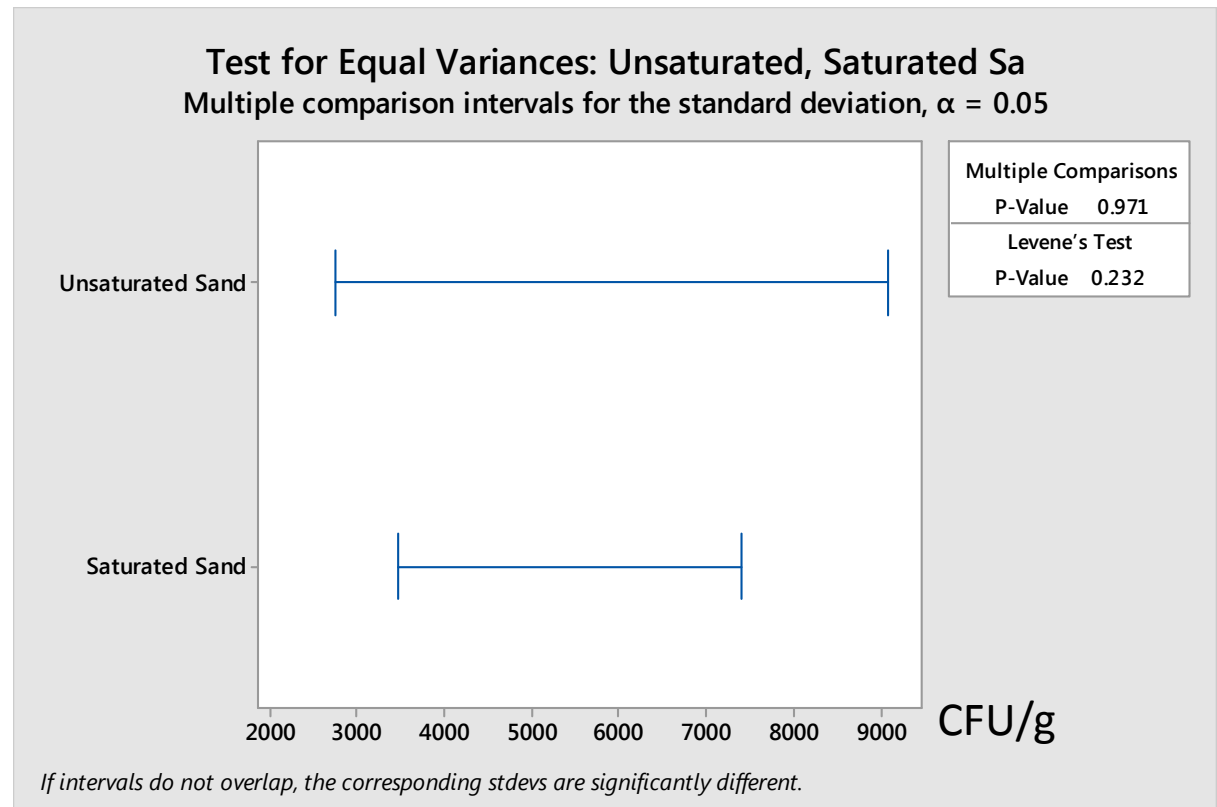
No significant difference between saturated sand collection methods.



Which component of the reservoir is the least variable for sampling?

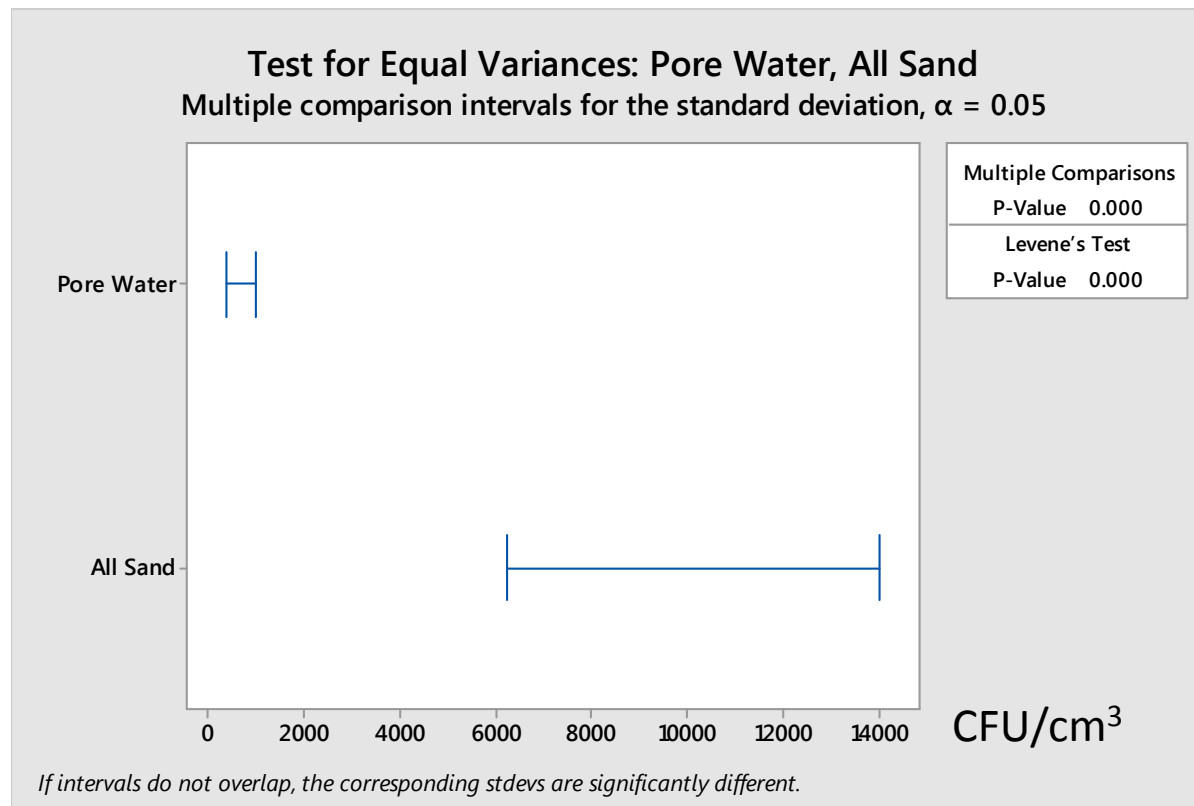
E. coli variability in the sand

- Unsaturated and saturated sand are equally variable ($p=0.232$)



Variability in sand and pore water

- Sand (unsaturated and saturated) is more variable than pore water ($p < 0.001$)



Conclusions

When considering data for individual beaches,

- No statistical difference between *E. coli* concentrations when comparing sampling methods
- The sampling method used affects the amount of *E. Coli* released from the sand into the pore water

Conclusions

When considering data for all beaches,

- sampling pore water using a drive point results in lowest observed concentrations
- unsaturated sand has higher concentrations than saturated sand
- the top ~1 cm of unsaturated sand has more *E. coli* than the top ~5cm
- *E. coli* concentrations in the sand are more variable than in pore water

Acknowledgements



Supporting organizations:

